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ORIGINAL ARTICLE

Population fluctuation of some insect pests infesting sugar beet and the associated predatory insects at Kafr El-Sheikh Governorate

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Abstract The experiments were performed on sugar beet crop at the farm of Sakha Agricultural Research Station in Kafr El-Sheikh Governorate throughout two successive seasons (2011 and 2012) to study the population fluctuations of the main insects of sugar beet plants and their associated predators. The results showed that the sugar beet plants were harbored three main insect species i.e. *Cassida vittata*)Vill); *Pegomyia mixta* Vill and *Scrobipalpa ocellatella* Boyd. Four predatory species were associated with the three insect pests i.e. *Coccinella undecimpunctata* L.; *Scymnus* sp., *Paederus alfierii* Koch. and *Chrysoperla carnea* (Steph.). Results revealed that the highest infestation levels of these insect pests were occurred during March and April in both seasons. The population densities of these pests were relatively higher during first season than the second one. Larvae of *C. vittata* showed two of peaks seasonal abundance in both seasons during late February and late March in the first season (10 and 230 larvae/25 plants, respectively) and during early and mid-April in the second season (29 and 35 larvae/25 plants, respectively). Also results showed that during the first season peaks occurred about one month earlier than the second season as there were manifest declines in the temperature throughout the second season. Larvae of *P. mixta* recorded three peaks at late December, early February and mid-March (15, 72 and 143 larvae/25 plants, respectively) during the first season. Also during the second season three peaks were recorded at mid-December, late January and mid-March (13, 22 and 114 larvae/25 plants, respectively) with considerable decline in larval population throughout the second season. Larvae of *S. ocellatella* occurred were during the period from December till late May on sugar beet plants with apparent oscillations. The number of larvae gradually increased till it reached 12 larvae/25 plants (mid-April 2011) and 9 larvae/25 plants (early May 2012). Peaks were unclear because the mean number of larvae was relatively few. Results concerning the four predator species found associated with these insect pests showed that during the first season the population of *C. undecimpunctata* increased gradually till it

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reached the highest peak at the second week of May (59 beetles/25 plants). The population of *C. carnea* was fluctuated till it reached the highest peak at the second week of April (12 Larvae/25 plants). Both *Scymnus* spp. and *P. alfierii* were found with few numbers. During the second also the population of *C. undecimpunctata* started to build up at the second week of April till the end of the season. The highest mean number of *C. undecimpunctata* was 21 beetles/25 plants were occurred at the third week of May. The population of *Scymnus* spp. also increased gradually till the end of the season with the highest number (30 beetles/25 plants) was occurred at the third week of May. The larval population of *C. carnea* started to increase gradually till it reached the highest peak at the second week of May (19 larvae/25 plants). *P. alfierii* was represented with few numbers. These results revealed that the appearance of *C. undecimpunctata*, *Scymnus* spp. and *P. alfierii* on sugar-beet plants followed the appearance of *P. mixta* and *S. ocellatella* and most probably these predators were fed on other hosts before attacking other insect pests such as aphids and lepidopterous larvae. The synchronization of *S. ocellatella* larvae and their predators occurred during April and May during the both seasons.

Introduction

Sugar beet; *Beta vulgaris* L. is considered as one of the two main sugar crops in Egypt. Under Egyptian ecosystem, sugar beet plants are attacked by numerous insect pests during its different growth stages. Tortoise beetle *Cassida vittata* (Vill); sugar beet fly *Pegomyia mixta* (Vill.) and beet moth *Scrobipalpa ocellatella* (Boyd.) are considered as the most important insect pests in Kafr El-Sheikh Governorate (Metwally et al., 1987; Abo-Aiana, 1991; Amin et al., 2008). These insect pests are considered to be the main reasons for sugar beet yield reductions (Evaristo, 1983) and the plants severely attacked by these insects were suffered from a great reduction in the main characters of crop plants and consequently in sugar production (Bassyouny et al., 1993).

Biological control approach is considered as a main component of the integrated pest management programs (IPM). Natural enemies are usually efficient in regulating population of insect pests, especially in balanced ecosystem. Pesticides alone will not solve the problem for controlling pests. In Egypt, insect predators; e.g. coccinellids and staphylinids were often surveyed from sugar beet fields (Abo-Saied, 1987; Boraei et al., 1993; El-Agamy et al., 1996; Shalaby, 2001).

The present work was outlined to evaluate the population dynamics between these main insect pests which attack sugar beet and their associated natural enemies under field conditions in Kafr El-Sheikh Governorate.

Materials and methods

Field study was carried out at a farm assigned by Sakha Agriculture Research Station in Kafr El-Sheikh Governorate during two successive seasons; 2010/2011 and 2011/2012. The experimental area was one feddan cultivated with sugar beet (Kawemira variety) in mid-November for both seasons. All recommended agricultural practices were followed during the growing season without insecticide applications. Sampling procedures were started one month after sowing at weekly intervals and continued until the harvest time. The plants were visually examined in the field with counting the insect pests and their associated predators.

Population fluctuations of the main insects

To estimate the seasonal fluctuation of population densities of the main insect pests weekly samples consisted of 25 plants were taken randomly. These plants were visually examined in the field and these samples were taken inside plastic sacks to the laboratory to count the larvae of the main insect pests throughout the two successive seasons.

Population fluctuations of the associated predators

To estimate population densities of predator species found associated with the main pests of sugar beet plants sampling procedures were started from mid-December and continued till the end of the season. Each sample consisted of 25 plants taken randomly every week. These plants were visually examined in the field to estimate number of chrysopid larvae, while adults of Coleopterus predators were estimated by 50 double strokes by sweeping net. The catch of each sample was anaesthetized into plastic sacks with a piece of wool cotton moistened with chloroform then embedded into glass jars and transferred into the laboratory for counting the predators.

Results and discussion

Population fluctuations of the main insect pests

Results revealed that sugar beet plants were attacked by three main pests during the both seasons under field condition of Kafr El-Sheikh Governorate. These species were identified as follows i.e. tortoise beetle *Cassida vittata* (Vill.); sugar beet fly *Pegomyia mixta* Vill. and beet moth *Scrobipalpa ocellatella* (Boyd.). It was found more convenient to discuss the results for each species separately. Weekly counts of larval contents of these three insect pests and their associated predators are given in Tables 1 and 2 during the two seasons in Kafr El-Sheikh Governorate.

Cassida vittata

Results showed that *C. vittata* larvae began to occur during the period elapsed from late February till mid-May on sugar beet

Table 1 Weekly mean numbers of the three main pests attacking sugar beet plants during 2010/2011 seasons and their associated natural enemies in Kafr El-Sheikh Governorate.

Sampling date	Mean No. of Larvae/25 plants			Mean No. of adult predators/25 plants and 50 double stroke			Mean No. of Larvae /25 plants
	C. vittata	*P. mixta*	*S. Ocellatella*	*C. undecimpunctata*	*Scymnus spp.*	*P. alfierii*	*C. carnea*
December 16 2010	0	0	0	0	0	0	0
23	0	13	2	0	0	0	0
30	0	15	3	0	0	0	0
Mean	0.0	9.3	1.7	0.0	0.0	0.0	0.0
January 6 2011	0	1	4	0	0	0	0
13	0	2	0	0	0	0	0
20	0	4	1	0	0	0	0
27	0	30	0	5	0	0	0
Mean	0.0	9.3	1.3	1.3	0.0	0.0	0.0
February 3	0	54	1	1	0	0	1
10	0	72	0	0	0	0	2
17	0	35	0	0	0	0	0
24	10	64	0	0	0	0	0
Mean	2.5	56.3	0.3	0.3	0.0	0.0	0.8
March 3	2	94	0	0	0	0	0
10	8	137	1	0	0	0	2
17	60	140	0	0	0	0	1
24	113	143	8	0	0	0	2
31	230	114	7	0	0	0	0
Mean	70.6	125.6	3.2	0.0	0.0	0.0	1.0
April 7	183	68	5	0	0	1	0
14	136	22	3	4	0	0	12
21	36	2	12	21	0	0	0
28	12	3	6	54	2	1	4
Mean	91.8	23.3	6.5	19.8	0.5	0.5	4.0
May 5	9	0	4	51	4	0	8
12	9	0	2	59	2	1	2
19	0	0	0	30	0	0	0
Mean	6.0	0.0	2.0	46.7	2.0	0.3	3.3
Total	808	1013	59	225	8	3	34
Mean	35.1	44.0	2.6	9.8	0.4	0.1	1.5

plants during the two seasons. The number of larvae gradually increased till it reached 230 larvae/25 plants (late March 2011) and 35 larvae/25 plants (mid-April 2012).

It was observed that the second larval peak of *C. vittata* was much higher (230 larvae/25 plants) during the first season than the second one (35 larvae/25 plants), also first season peaks occurred about one month earlier than the second season as there were manifest declines in the temperature throughout the second season 2011/2012; Fig. 1.

During the first season larvae of *C. vittata* showed two peaks in both seasons during late February and late March 2011 (10 and 230 larvae/25 plants, respectively), while during the second season the two peaks were occurred during early and mid-April 2012 (29 and 35 larvae/25 plants, respectively). These results are in agreement with those obtained by Abo-Aiana (1991) who reported that *C. vittata* has two larval peaks on sugar beet plants in Kafr El-Sheikh Governorate. Guirguis (1985) recorded three peaks for larvae of *C. vittata* at Nubaria region, from March to July, 1983. Salama and Elnagar (1992) stated that an apparent outbreak of the tortoise beetle *C. vittata* was observed in 1988/89 season, while the peak of *C. vittata* larvae occurred during March/May on sugar beet plantation in Egypt.

Pegomyia mixta

Results showed that the larvae of *P. mixta* were occurred throughout the period from late December till late April on sugar beet plants throughout the two seasons. Three peaks were recorded at late December, early February and mid-March in the first season represented by 15, 72 and 143 larvae/25 plants, respectively. Also in the second season these three peaks were recorded at mid-December, late January and mid-March represented by 13, 22 and 114 larvae/25 plants, respectively with considerable decline in larval population throughout the second season.

Also results showed that sugar beet plants were harbored more numbers of *P. mixta* larvae during the first season than the second one. The mean number of larvae in the first season was 44.0 larvae/25 plants while in the second season it was 20.1 larvae/25 plants. Mohisen (2012) stated that *P. mixta* larvae attacked sugar beet plantations from November until late February, and reach its maximum abundance

Table 2 Weekly mean numbers of the three main pests attacking sugar beet plants during 2011/2012 seasons and their associated natural enemies in Kafr El-Sheikh Governorate.

Sampling date	Mean No. of Larvae/25 plants			Mean No. of adult predators/25 plants and 50 double stroke			Mean No. of Larvae/25 plants
	C. vittata	*P. mixta*	*S. Ocellatella*	*C. undecimpunctata*	*Scymnus spp.*	*P. alfierii*	*C. carnea*
December 16 2011	0	0	0	0	0	0	0
23	0	13	1	0	0	0	0
30	0	12	2	0	0	0	0
Mean	0.0	8.3	1.0	0.0	0.0	0.0	0.0
January 6 2012	0	7	1	0	0	0	0
13	0	4	1	0	0	0	0
20	0	2	2	0	0	0	1
27	0	22	0	0	0	0	3
Mean	0.0	8.8	1.0	0.0	0.0	0.0	1.0
February 3	0	13	1	3	0	0	1
10	0	0	0	0	0	0	5
17	0	1	2	0	0	0	3
24	0	1	0	0	0	0	2
Mean	0.0	3.8	0.8	0.8	0.0	0.0	2.8
March 3	0	6	2	0	0	1	0
10	0	11	4	1	0	0	2
17	5	59	2	0	0	0	6
24	7	114	1	0	0	0	2
31	18	89	4	0	0	0	1
Mean	6.0	55.8	2.6	0.2	0.0	0.2	2.2
April 7	29	64	7	0	0	0	3
14	18	35	5	3	0	0	4
21	35	6	4	3	0	0	2
28	25	3	4	2	0	0	7
Mean	26.8	27.0	5.0	2.0	0.0	0.0	4.0
May 05	16	0	9	3	2	0	17
12	13	0	5	12	16	1	19
19	0	0	0	21	30	0	4
Mean	9.8	0.0	4.7	12.0	16.0	0.3	13.3
Total	166	462	57	48	48	2	82
Mean	7.2	20.1	2.5	2.1	2.1	0.1	3.6

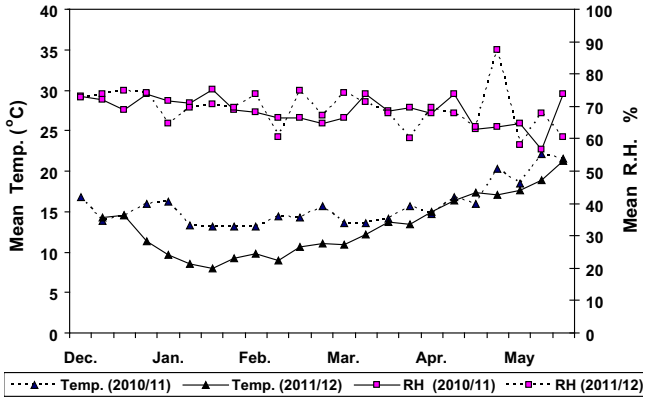

Fig. 1 Daily mean temperature (°C) and R.H. (%) in Kafr El-Sheikh Governorate throughout the two successive seasons (2010/2011 and 2011/2012).

during spring i.e. from March to May in Kafr El-Sheikh Governorate.

Scrobipalpa ocellatella

Results in Tables 1 and 2 showed that *S. ocellatella* larvae were occurred during the entire period from December till mid-May on sugar beet plants during the two seasons with apparent oscillations. The numbers of larvae were gradually increased till it reached 12 larvae/25 plants mid-April 2011 and 9 larvae/25 plants at early May 2012. Peaks are unclear because the mean numbers of larvae were relatively few.

Population fluctuation of the associated predators

During the two growing seasons of sugar beet plants in Kafr El-Sheikh Governorate four predator species were found associated with the three main insect pests. These predator species were identified as follows: two coccinellid species, *Coccinella undecimpunctata*, *Scymnus* sp.; one staphylinids species, *Paederus alfierii* and one chrysopid species, *Chrysoperla carnea*.

Data obtained during 2010/2011 growing season are given in Table 1. These results show that the first appearance of *C. undecimpunctata* was recorded at the 4th week of January

(5 and beetles/25 plants) which remained only for a couple of weeks. The second appearance was at the second week of April 2011 represented by 4 beetles/25 plants. The population was increased gradually till it reached the highest peak at the second week of May 2011 represented by 59 beetles/25 plants. The larvae of *C. carnea* firstly occurred at the first week of February represented by 1 larva/25 plants and the population was fluctuating till it reached the highest peak at the second week of April 2011 (12 adults/25 plants). Both *Scymnus* spp. and *P. alfierii* showed very few numbers with a total of 8 and 3 individuals, respectively.

During the second season (2011–2012) data obtained are given in Table 2. These results showed that the first appearance of *C. undecimpunctata* was recorded in early February 2012 represented by 3 beetles/25 plants. The population started to build up throughout the successive weeks and reached the highest mean number of 21 adult individuals/25 plants at the third week of May 2012. Adult of *Scymnus* spp. firstly occurred at the beginning of May

(2 adults/25 plants) and increased gradually till the end of the season with the highest number of adults (30/25 plants). The larvae of *C. carnea* firstly occurred at the third week of January (1 larva/25 plants) and maintained in low numbers and started to increase gradually till it reached the highest peak at the second week of May 2012 (19 larvae/25 plants). *P. alfierii* showed very few numbers (a total of 2 individuals in the whole season). Mahmoud et al. (1970), Mesbah (1991) and El-Khouly (2006) reported that the population of coccinellids started to increase in March and April and reached their higher peaks in April and May.

The appearance of *C. undecimpunctata*, *Scymnus* spp. and *P. alfierii* on sugar-beet plants followed the appearance of *P. mixta* and *S. ocellatella* and most probably these predators were fed on other hosts before attacking these insect pests such as aphids and lepidopterous larvae. The synchronization of *S. ocellatella* larvae and their predators occurred during April and May.

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